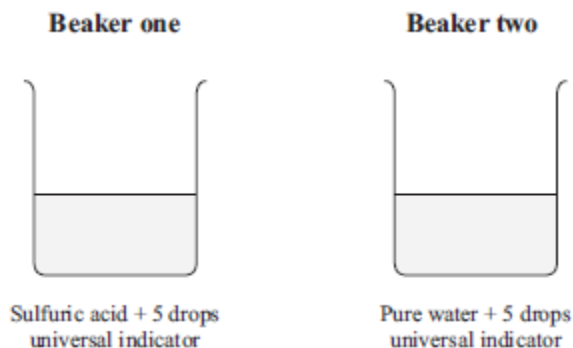


Acids and Bases

1) Two beakers are shown below. Beaker one contains sulfuric acid solution and 5 drops of universal indicator. Beaker two contains pure water and 5 drops of universal indicator. Sodium hydroxide solution was added to both beakers until no more changes were observed.



- a) Write a word equation AND a balanced symbol equation for the reaction between sulfuric acid and sodium hydroxide.
- b) What is the colour of universal indicator in each solution at the **start**?
- c) Describe the colour changes as sodium hydroxide solution is added to each beaker, AND explain what this tells you about the changing pH of each solution.
- d) Explain the relationship between the pH of the solutions and the **ions** in the solutions, as the sodium hydroxide is added to each of the beakers.
- 2) A student puts 5 mL of dilute hydrochloric acid into a boiling tube and adds five drops of universal indicator to the solution. The student then takes a solution of sodium hydroxide of the same concentration as the acid and adds it one drop at a time to the acid until the colour stops changing.
- a) i) Describe the colour of the universal indicator solution:
- in the hydrochloric acid before any sodium hydroxide was added.
 - when the sodium hydroxide was added and the colour of the solution **stopped changing**.

ii) As the sodium hydroxide is added several colour changes occur. Explain how the colour changes relate to pH AND what ions are present in the solution colour changes.

b) The student combines **equal** volumes of nitric acid solution and sodium carbonate solution. Both solutions have the **same concentration**. Discuss what happens in this reaction. In your answer, you should:

- name the type of reaction involved and the ions involved
- describe what the student would observe
- state the products of the reaction and link these to the observations made
- write a word equation for the reaction
- write a balanced symbol equation for the reaction.

3) A student reacted dilute sulfuric acid solution with solid sodium hydrogen carbonate. Discuss the reasons for any observations the student would make for this reaction. In your answer you should:

- Describe any observations the student would make for this reaction.
- Write a word equation and balanced symbol equation for the reaction of sulfuric acid with sodium hydrogen carbonate.
- Explain how the observations link to the products formed.

4) A student carried out an experiment to **neutralise** sulfuric acid by adding sodium hydroxide to it. Discuss **how** the student could have determined when the sulfuric acid had been neutralised **and** what effect adding the sodium hydroxide has on the pH of the solution. In your answer include:

- an explanation of neutralisation in terms of an acid-base reaction
- the name of the indicator used
- observations that the student would make as the sodium hydroxide is added to the acid
- a word and balanced chemical equation for the reaction.

5) An important part of keeping swimming pools safe is to keep the pH of the water balanced in the range 7.0 to 7.6. Three chemicals used in pools are chlorine compounds (that react with water to produce hydrochloric acid), sodium hydrogen carbonate and aluminium sulfate.

a) Complete the following table to show the characteristics of the solutions listed in the table below.

Solution	Estimated pH	Colour when tested with Universal indicator
Hydrochloric acid	1	(i)
Sodium hydrogen carbonate	(ii)	blue
Aluminium sulfate	5	(iii)
Water	(iv)	green

b) The pool was tested and found to have a pH of 6.5. Sodium hydrogen carbonate was used to raise the pH of the water. Discuss how sodium hydrogen carbonate raised the pH of the water, and include in your answer a word equation **and** a symbol equation for the reaction of sodium hydrogen carbonate with hydrochloric acid.

6) Epsom salt has the chemical formula MgSO_4 . It can be prepared by reacting an acid with magnesium hydroxide.

a)i) Give the chemical name for MgSO_4

ii) Name the acid used in this reaction

b) Write the word equation for the preparation of MgSO_4 .

c) This reaction is described as a **neutralisation** reaction. Explain what is meant by the term **neutralisation**.

7) i) A student has one test tube containing magnesium oxide and another containing magnesium carbonate. Both substances are white powders. The student has to identify which test tube contains magnesium oxide and which test tube contains magnesium carbonate, using only sulfuric acid. Explain how the student would do this.

ii) Magnesium hydroxide also reacts with sulfuric acid. Write a **balanced symbol** equation for this reaction.

8) Hydrochloric and sulfuric acids both react with carbonates and hydrogen carbonates to produce a gas.

i) Name the gas.

ii) Write the **word equation** for the reaction of hydrochloric acid with copper carbonate.

iii) Write a fully balanced **symbol equation** for the reaction of sulfuric acid with sodium hydrogen carbonate.

iv) Explain why the reactions of acids with carbonates and hydrogen carbonates are called neutralisation reactions.